

a plurality of free-standing elongated electrical conductors, each of the elongated electrical conductors having a first end, a second end, and a compliant section between the first end and the second end, selected ones of the free-standing elongated electrical conductors each mounted by a first end thereof to and extending from a respective selected one of the contact locations and the respective compliant section thereof flexing against compliant action when a force is applied to the respective second end thereof and to compliantly respond when the force is relieved; and

the second ends of the elongated electrical conductors are at an angle with respect to said first end and the contact location, the angle being between a minimum and a maximum value.

145

146. (Added) A semiconductor device, according to claim 145, wherein:

the elongated electrical conductors having a second end at an angle with respect to the first end have a bend to accommodate the angle between the minimum and maximum angle.

146

147. (Added) A semiconductor device, according to claim 146, wherein:

the contact locations are disposed a first distance apart;

the second ends of the elongated electrical conductors are disposed at a second distance apart; and

the second distance is determined by the angle.

147

148. (Added) A semiconductor device, according to claim 147, wherein:

the first distance is approximately 5 mils.

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148. (Added) A semiconductor device, according to claim 146, further comprising:

a dielectric material extending over a surface of the silicon body and enveloping a portion of the elongated electrical conductors.

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149. (Added) A semiconductor device, according to claim 146, wherein:

the silicon body is covered by an electrically insulating coating having holes and comprises electrically conductive throughholes and electrical conductors electrically connected to the contact locations.

~~150~~

150. (Added) A semiconductor device, according to claim 146, further comprising:

metallization covering the elongated electrical conductors.

~~151~~

151. (Added) A semiconductor device, according to claim 146, wherein:

the elongated electrical conductors are composite structures.

~~152~~

152. (Added) A semiconductor device, according to claim 146, wherein:

the contact structures are resilient contact structures.

~~153~~

153. (Added) An electronic assembly comprising:

a substrate having a plurality of contact locations on one side thereof; and

a plurality of resilient, elongated electrical conductors, wherein:

(i) each elongated electrical conductor has a first end attached to a respective one of the contact locations, and a second end, distant from the substrate, the second ends of the elongated electrical conductors are at an angle with respect to the first end of the elongated electrical conductor and the contact location, the angle being between a minimum and maximum value and the first end of a first of the elongated electrical conductors is spaced from the first end of a second, adjacent one of the elongated electrical conductors by a first distance and the second end of the first elongated electrical conductor is spaced from the second end of the second elongated electrical conductor by a second distance which is determined by the angles corresponding to the first and second elongated electrical conductors; and

(ii) each elongated electrical conductor comprises a flexible elongated element, and a second material on the flexible elongated element, the flexible elongated element having a first composition and the second material having a second composition which is different from the first composition.

154
155. (Added) The electronic assembly of claim 154, wherein the first composition comprises a material selected from the group consisting of gold, aluminum, copper, nickel, platinum, gold alloy, copper alloy and palladium.

155
156. (Added) The electronic assembly of claim 154, wherein the first material comprises gold.

156
157. (Added) The electronic assembly of claim 154, wherein the second material is selected from the group consisting of Au, Cr, Co, Ni and Pd.

157
158. (Added) The electronic assembly of claim 154, wherein at least one layer of the second material is selected from the group consisting of nickel and cobalt.

~~158~~

~~158.~~ (Added) The electronic assembly of claim 154, wherein the flexible elongated electrical conductor has disposed thereon the second material.

~~159~~

~~159.~~ (Added) The electronic assembly of claim 154, wherein the second material is selected from the group consisting of an electroless plated coating, an e-beam deposited coating, a sputter deposited coating and an electroplated coating.

~~160~~

~~160.~~ (Added) An electronic assembly comprising:

a substrate having a plurality of contact locations on one side thereof; and

a plurality of flexible elongated electrical conductors, each flexible elongated electrical conductor having a first end attached to a respective one of the contact locations and a second end, distant from the substrate, which are resiliently depressible towards the substrate, the second ends of the elongated electrical conductors are at an angle with respect to the first end of the elongated electrical conductor and the contact location, the angle being between a minimum and maximum value wherein:

(i) the first ends of two of the flexible elongated electrical conductors located next to one another are spaced by a first distance from one another; and

(ii) the second ends of the two elongated electrical conductors are spaced by a second distance from one another which is determined by the angle corresponding to the first and second elongated electrical conductors both

(a) when the two flexible elongated electrical conductors are not depressed towards the substrate and

(b) when the second ends are depressed towards the substrate; and

(iii) each elongated electrical conductor comprises a flexible elongated element of a first material, and a second material on the flexible elongated element, the flexible elongated element having a first composition and the second material having a second composition which is different from the first composition.

161

162. (Added) The electronic assembly of claim 161, wherein the second end of each flexible elongated electrical conductor is an area of the flexible elongated electrical conductor which is most distant from the substrate and remains most distant both when the flexible elongated electrical conductor is not depressed towards the substrate and when the second end is depressed towards the substrate.

162

163. (Added) An electronic assembly comprising:

a substrate having a plurality of contact locations on one side thereof; and

a plurality of flexible elongated electrical conductors, each flexible elongated electrical conductor having a first end attached to a respective one of the contact locations, and a second end most distant from the substrate, the second ends of the elongated electrical conductors are at an angle with respect to the first end of the elongated electrical conductor and the contact location, the angle being between a minimum and maximum value, the flexible elongated electrical conductor is resiliently depressible towards the substrate, wherein the first locations of two of the flexible elongated electrical conductor located next to one another are spaced from one another by a first distance and the second ends of the two elongated electrical conductors are spaced from one another by a second distance which is determined by the angles corresponding to the first and second flexible elongated electrical conductors, the second ends

of each of the two flexible elongated electrical conductors being an area of the flexible elongated electrical conductor which is most distant from the substrate and remaining most distant from the substrate after depression of the second end towards the substrate, each flexible elongated electrical conductor comprising a flexible elongated element of a first material, and a second material on the flexible elongated element, the flexible elongated electrical conductor having a first composition and the second material having a second composition.

103
164. (Added) A semiconductor device comprising:

a silicon body having a plurality of contact locations; and

a plurality of free-standing elongated electrical conductors, each of the free-standing elongated electrical conductors having a first end, a second end, a first portion having a first bend, and a second portion having a second bend selected ones of the free-standing elongated electrical conductors mounted by a respective first end thereof to and extending from a respective selected one of the contact locations, the second ends of the elongated electrical conductors are at an angle with respect to the first end of the elongated electrical conductor and the contact location, the angle being between a minimum and maximum value; wherein the second ends of at least a portion of the elongated electrical conductors are spaced apart as determined by the angles corresponding to the first and second elongated electrical conductors.

104
165. (Added) A semiconductor device comprising:

a silicon body having a plurality of contact locations; and

a plurality of free-standing elongated electrical conductors, and each of the free-standing elongated electrical conductors having a first end and a second end, selected ones of the free-standing elongated electrical conductors mounted by a respective first end thereof to and extending from a respective selected one of the contact locations, the second ends of the elongated electrical conductors are at an angle with respect to the first end of the elongated electrical conductor and the contact location, the angle being between a minimum and maximum value; wherein

(i) the contact locations are spaced approximately 5 mils apart; and

(ii) the second ends are spaced as determined by the angles corresponding to the first and second elongated electrical conductors.


~~106.~~ (Added) A semiconductor device comprising:

a silicon body having a plurality of contact locations;

a plurality of free-standing elongated electrical conductors, each of the free-standing elongated electrical conductors having a first end and a second end, selected ones of the free-standing elongated electrical conductors mounted by a respective first end thereof to and extending from a respective selected one of the contact locations, the second ends of the elongated electrical conductors are at an angle with respect to the first end of the elongated electrical conductor and the contact location, the angle being between a minimum and maximum value, wherein second ends of at least a portion of the elongated electrical conductors are spaced apart as determined by the angles corresponding to the first and second elongated electrical conductors; and

a dielectric material extending over a surface of the silicon body and enveloping a portion of the elongated electrical conductors.

164
~~107.~~

(Added) A semiconductor device comprising:

a silicon body having a plurality of contact locations;

a plurality of free-standing elongated electrical conductors, each of the free-standing elongated electrical conductors having a first end and a second end, selected ones of the free-standing elongated electrical conductors mounted by a respective first end thereof to and extending from a respective selected one of the contact locations, wherein the second ends of the elongated electrical conductors are at an angle with respect to the first end of the elongated electrical conductor and the contact location, the angle being between a minimum and maximum value;

(i) second ends of at least a portion of the second ends are spaced as determined by the angles corresponding to the first and second elongated electrical conductors;

(ii) the silicon body is covered by an electrically insulating coating having through holes therethrough whereby the contact locations are accessible through the electrically insulating coating;

(iii) a plurality of additional conductive material elements extend through the passivation layer to contact the contact locations; and

(iv) the elongated electrical conductor are mounted to the additional conductive material.

167
~~168.~~

(Added) A semiconductor device, according to claim 167, further comprising:

metallization covering the elongated electrical conductor.

168
~~169.~~

(Added) An electronic assembly comprising:

a substrate having a plurality of contact locations on one side thereof; and

a plurality of resilient, elongated electrical conductors:

(i) each elongated electrical conductor has a first end attached to a respective one of the contact locations, and a second end, distant from the substrate, the second end of the elongated electrical conductor is at an angle with respect to the first end of the elongated electrical conductor and the contact location, the angle being between a minimum and maximum value, and the first end of a first of the elongated electrical conductors is spaced from the first end of a second, adjacent one of the elongated electrical conductors by a first distance and the second end of the first elongated electrical conductor is spaced from the second end of the second elongated electrical conductor by a second distance which is determined by the angles corresponding to the first and second elongated electrical conductors;

(ii) each elongated electrical conductor comprises a flexible elongated element of a first material being gold, and a second material on the flexible elongated element, the flexible elongated element having a first composition and the coating having a second composition which is different from the first composition.

169
~~170.~~

(Added) An electronic assembly comprising:

a substrate having a plurality of contact locations on one side thereof; and

a plurality of resilient, elongated electrical conductors:

(i) each elongated electrical conductor has a first end attached to a respective one of the contact locations, and a second end, distant from the substrate, wherein the second end of the elongated electrical conductor is at an angle with respect to the first end of the elongated electrical conductor and the contact location, the angle being between a minimum and maximum value, and the first end of a first of the elongated electrical conductors is spaced from the first end of a second, adjacent one of the elongated electrical conductors by a first distance and the second end of the first elongated electrical conductor is spaced from the second end of the second elongated electrical conductor by a second distance which is determined by the angles corresponding to the first and second elongated electrical conductors; and

(ii) each elongated electrical conductor comprises a flexible elongated electrical conductor of a first material, and a second material on the flexible elongated element, the flexible elongated element having a first composition and the coating having a second composition which is different from the first composition.

170
~~171.~~

(Added) An electronic assembly comprising:

a substrate having a plurality of contact locations on one side thereof; and

a plurality of resilient, elongated electrical conductors:

(i) each elongated electrical conductor has a first end attached to a respective one of the contact locations, and a second end, distant from the substrate wherein the second ends of the elongated electrical conductors are at an angle with respect to the first end of the elongated electrical conductor and the contact location, the angle being between a minimum and maximum value, and the first contact location of a first of the elongated electrical conductors is spaced from the first end of a second, adjacent one of the elongated electrical conductors by a first distance and the second end of the first elongated electrical conductor is spaced from the second end of the second elongated electrical conductor by a distance which is determined by the angles corresponding to the first and second elongated electrical conductors; and

(ii) each elongated electrical conductor comprises a flexible elongated element of a first material, and a second material, comprising nickel, iron or cobalt, on the flexible elongated element, the flexible elongated element having a first composition and the coating having a second composition which is different from the first composition.

171

~~172.~~ (Added) An electronic assembly comprising:

a substrate having a plurality of contact locations on one side thereof; and

a plurality of resilient, elongated electrical conductors:

(i) each elongated electrical conductor has a first end attached to a respective one of the contact locations, and a second end, distant from the substrate wherein the second ends of the elongated electrical conductors are at an angle with respect to the first end of the elongated electrical conductor and the contact location, the angle being between a minimum and maximum value, and the first end of a first of the elongated

electrical conductor is spaced from the first end of a second, adjacent one of the elongated electrical conductors by a first distance and the second ends of the first elongated electrical conductor is spaced from the second end of the second elongated electrical conductor by a second distance which is determined by the angles corresponding to the first and second elongated electrical conductors; and

(ii) each elongated electrical conductor comprises a flexible elongated element of a first material, and a second material on the flexible elongated element, the flexible elongated element having a first composition and the coating having a second composition which is different from the first composition.

172
~~173.~~ (Added) A semiconductor device according to any one of claims 145, 164, 165, 166 or 167, wherein the minimum value is 5 degrees and the maximum value is 60 degrees.

173
~~174.~~ (Added) A semiconductor device according to any one of claims 145, 164, 165, 166 or 167, wherein as a result of the angle being between the minimum and the maximum values, the second ends are at a spacing different than the spacing of the first ends.

174
~~175.~~ (Added) An electronic assembly according to anyone of claims 154, 161, 163, 169, 170, 171 or 172, wherein the minimum value is 5 degrees and the maximum value is 60 degrees.

175
~~176.~~ (Added) An electronic assembly according to anyone of claims 154, 161, 163, 169, 170, 171 or 172, wherein as a result of the angle being between the minimum and the maximum values, the second ends are at a spacing different than the spacing of the first ends.

174

~~177.~~

(Added) A structure comprising:

a substrate having a plurality of contact locations thereon;

a plurality of elongated electrical conductors, each having a first end and a second end;

said first end is electrically connected to one of said contact locations;

the second end of the elongated electrical conductor is at an angle with respect to said first end and said contact location to which said first end is electrically connected, the angle being between a minimum and a maximum value.

177

~~178.~~

(Added) A structure according to claim 177, wherein the minimum value is 5 degrees and the maximum value is 60 degrees.

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~~179.~~

(Added) A structure according to claim 177, wherein as a result of the angle being between said minimum and said maximum values, the second ends are at a spacing different than the spacing of the first ends.

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~~180.~~

(Added) A structure according to claim 177, further including a coating on said elongated electrical conductors.

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~~181.~~

(Added) A structure according to claim 180, wherein the elongated electrical conductor comprises a first material and the coating comprises a second material.

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~~182.~~

(Added) A structure according to claim 181, wherein the second material is different than said first material.

~~182~~

~~183.~~ (Added) A structure according to claim 177, wherein the elongated electrical conductor comprises a material selected from the group consisting of gold, aluminum, nickel, platinum, gold alloy, copper alloy and palladium.

~~183~~

~~184.~~ (Added) A structure according to claim 180, wherein said coating comprises a material selected from the group consisting of Au, Cr, Co, Ni and Pd.

~~184~~

~~185.~~ (Added) A structure according to claim 177, wherein said substrate comprises silicon.

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~~186.~~ (Added) A structure according to claim 177, wherein said substrate comprises an electrically insulating coating.

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~~187.~~ (Added) A structure according to claim 177, wherein said substrate comprises electrical conductors and electrically conductive throughholes electrically interconnected to the contact locations and to the electrical conductors.

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~~188.~~ (Added) A structure according to claim 177, wherein said elongated electrical conductor is compliant and can be displaced so that the second end thereof moves in relation to the first end of said elongated electrical conductor when the second end is pressed against a surface.

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~~189.~~ (Added) A structure according to claim 177, wherein said elongated electrical conductor compliantly responds when said second end is released from being pressed against said surface.

~~189~~

~~190.~~ (Added) A semiconductor structure according to anyone of claims 145, 164, 165, 166 or 167, wherein the angle is nonorthogonal to the contact location.

~~190~~

~~191.~~ (Added) An electronic assembly according to anyone of claims 154, 161, 163, 169, 170, 171, or 172, wherein the angle is nonorthogonal to the contact location.

concluded
(11)
~~191~~

~~192.~~ (Added) A structure according to anyone of claims 177 to 191 or 193 to 195, wherein said angle is nonorthogonal to said one of said contact locations.

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~~193.~~ (Added) A structure according to anyone of claims 177 to 192 or 194 to 195, wherein the elongated electrical conductors are free-standing.

~~193~~

~~194.~~ (Added) A structure according to anyone of claims 177 to 193 or 195, further including a dielectric material disposed on said substrate and enveloping a portion of said elongated electrical conductor.

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~~195.~~ (Added) A structure according to anyone of claims 177 to 194, wherein said elongated electrical conductors are compliant.

REMARKS

Support for the added claims 64-144 is found throughout the specification and in US application serial number 07/685,368 filed on Oct. 19, 1992 incorporated by reference at page 7, lines 6-8 from the bottom, now issued as US 5,371,654 on December 6, 1994.

Claims 145-195 added herein are substantially identical to the claims of US 6,242,803 B1 which has an earliest claimed priority date of November 16, 1993. The present application is a continuation of US Application Serial Number 08/872,579, filed on 6/11/1997, now Issued as US 6,334,247 B1 which is a divisional of US Application Serial Number 08/754,869, filed on November 22, 1996, now issued as US 5,821,763 on October 13, 1998, which is a continuation of US Application Serial Number 08/055,485, filed on April 30, 1993 and now issued as US 5,635,846 on June 3, 1997. Therefore, US 5,371,654 and US 5,635,846 are both 35 USC 102(e) references against US 6,215,670.